SOLAR/2041-79/05

Monthly Performance Report

HOWARD'S GROVE SCHOOL

MAY 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
HOWARDS GROVE SCHOOL
MAY 1979

I. SYSTEM DESCRIPTION

This solar energy heating system is designed to provide 58 percent of the space heating for an addition to the North View Elementary School in Howards Grove, Wisconsin. The addition contains 12,330 square feet of heated space. The collector array has a total of 138 collector panels arranged in six rows, each row containing 23 flat-plate air collector panels. The array panels, manufactured by Sun Stone Solar Energy Equipment, have a gross area of 2,685 square feet. The collectors face south at an angle of 50 degrees from the horizontal. Air is the medium used for transferring energy from the collector array to storage. Solar energy is stored in a 16- by 21- by 6-foot concrete block bin containing 1,500 cubic feet of crushed rock located below the equipment room. When solar energy is inadequate to provide space heating, auxiliary thermal energy is supplied from a 397,200 Btu/hr fuel-oil boiler. The space heating control system modulates control dampers to mix outside air, return air and thermally heated air (solar and auxiliary) to maintain a building temperature of 67°F during the day and 55°F at night. A minimum of 10 percent fresh outside air is required by law to be mixed with return air.

This system, shown schematically in Figure 1, has three modes of operation.

<u>Mode 1 - Collector-to-Storage</u>: This mode is entered when the collector array outlet temperature exceeds the temperature at the bottom of rock thermal storage by at least 17°F. Air is drawn from the collector array, using the collector circulating fan F2, into the rock thermal storage and recirculated to the collectors. This mode continues until the collector outlet temperature no longer exceeds the temperature in the bottom of rock thermal storage by at least 4°F.

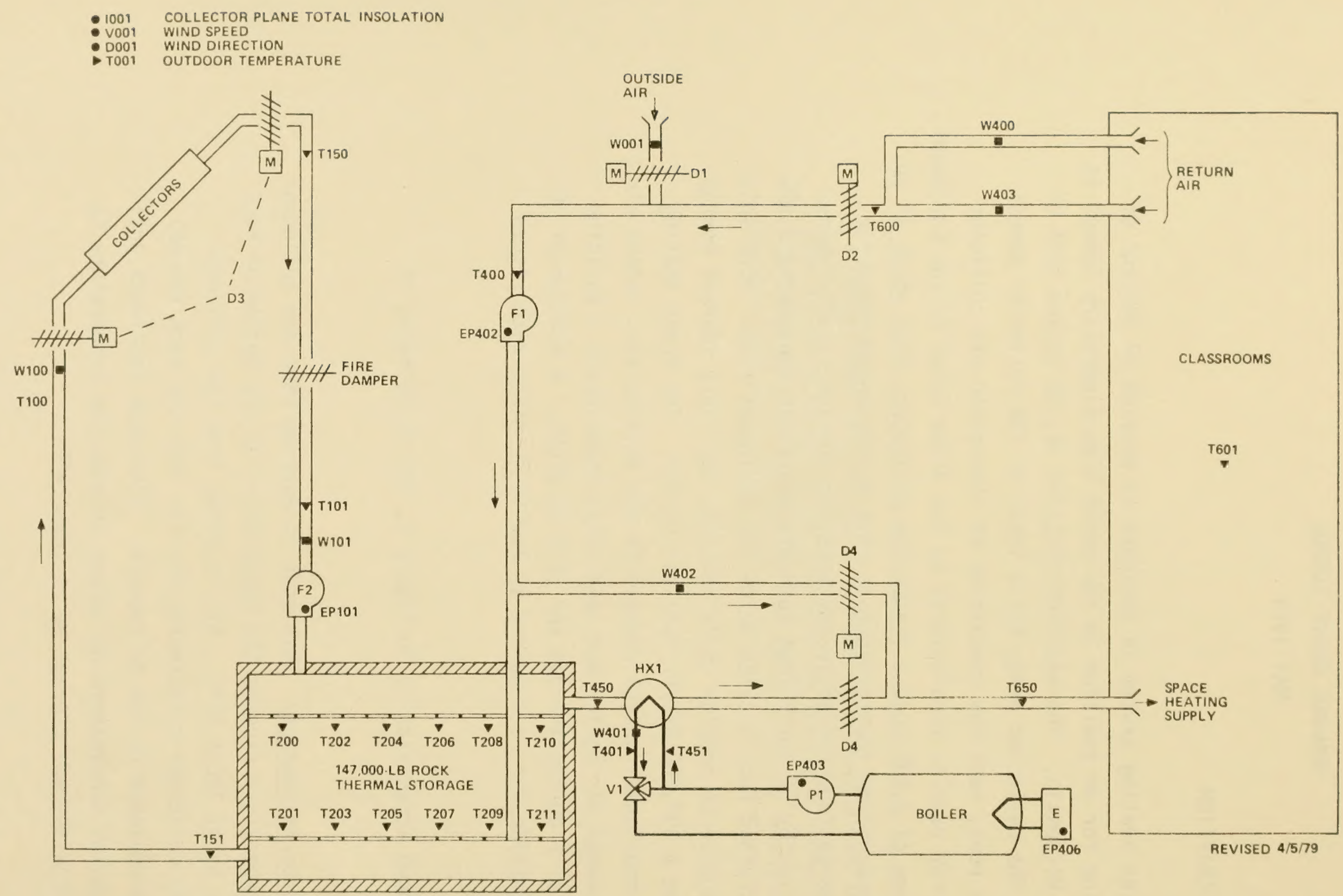

Figure 1. HOWARDS GROVE SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

Mode 2 - Storage-to-Classrooms (Occupied): This mode is entered at the beginning of each school day as determined by a seven-day clock timer. Circulation fan F1 runs continuously to transfer energy from storage, to classrooms, and to provide ventilation. Outside air and return air dampers are modulated to supply fresh air at a mixed return air temperature of 60°F. Multizone control dampers modulate the mixed return air with thermally heated air from storage to maintain the space heating system supply air temperature. The auxiliary fuel-oil boiler supplements solar energy to meet the space heating demand, and to maintain the building's indoor ambient temperature. The seven-day clock timer terminates this mode at the end of each school day. The clock timer may be manually overridden to provide Mode 2 heating for irregularly scheduled (outside normal class hours) school events.

Mode 3 - Storage-to-Classrooms (Unoccupied): This mode is entered when there is a demand for space heating and the system is not in the Occupied mode. The outside air damper D1 is closed. Circulating fan F1 runs when a space heating demand exists to transfer energy from storage to classrooms, and to provide ventilation. Multizone control dampers modulate the return air with thermally heated air from storage to maintain the space heating system supply temperature. The auxiliary fuel-oil boiler supplements solar energy to meet the space heating demand and to maintain the building's indoor ambient temperatures. This mode terminates when either the demand for space heating ceases, or the system is changed to the Occupied mode.

Mode 1 operation can occur while either Mode 2 or 3 is active.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the

definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

The solar energy system at the Howards Grove School site operated continuously during the month of May. The system supplied 64 percent of the space heating demand of 13.32 million Btu. Operation of the solar energy system resulted in a savings of 11.14 million Btu of fossil fuel (77 gallons of fuel oil) at an expense of 1.88 million Btu (550 kwh) of electrical energy.

B. Weather

May weather conditions were near normal. The measured outside ambient temperature was 53°F, which is 1°F lower than the 54°F predicted from long-term averages. The measured wind velocity was 4 mph, less than the 11.2 mph predicted from long-term averages. The long-term average environmental conditions were obtained from the environmental data listed in Climatography of the United States No. 81 (By State).

The cloud cover was normal, as indicated by the measured insolation of 1,494 Btu/ft^2-day. The predicted long-term monthly insolation is also 1,494 Btu/ft^2-day; this is derived from an average of the data for Green Bay and Milwaukee, Wisconsin, as listed in SOLMET Volume 1 - User's Manual.

C. System Thermal Performance

Collector - Of the 124.41 million Btu of solar energy incident on the collector array during May, 104.51 million Btu were incident on the array when fan F2 was operating. The system collected 33.95 million

Btu, or 27 percent of the total insolation incident on the collector array. However, the collected energy represents 32 percent of the operational incident energy. The operation of the collector circulating fan F2 required 1.34 million Btu of electrical energy.

Storage - From the indicated 33.95 million Btu of solar energy collected, 34.46 million Btu were delivered to rock thermal storage. (The slight energy imbalance is due to the uncertainty in the measurement of absolute temperatures in conjunction with large air flow rates.) A total of 8.47 million Btu was extracted from storage and delivered to the space heating subsystem. Storage lost 25.23 million Btu of solar energy which results in a storage efficiency of 27 percent.

Space Heating Load - The space heating load was near normal because the average monthly temperature of 53°F was near the 54°F predicted long-term average for May. The 392 heating degree-days measured at the site is above the 343 heating degree-days predicted from long-term averages. The design heating load for May was 46.9 million Btu based on data supplied through the Department of Energy. The design heating load was calculated assuming that a large controlled infiltration of outside air exists during normal operation of the site. This situation apparently existed during the month of May.

The measured space heating demand of 13.32 million Btu was satisfied by 8.47 million Btu of solar energy and 4.86 million Btu of auxiliary thermal energy resulting in a solar fraction of 64 percent. The 4.86 million Btu of auxiliary thermal energy for space heating were supplied by the consumption of 6.39 million Btu of fuel oil. This amounted to 44 gallons of fuel oil.

The analysis of the performance of storage revealed that the large circulating fan added energy to the building circulation air flow. This added energy produced a 1.5°F temperature rise across the circulation fan and, thus, contributed to satisfying the space heating demand. The magnitude of the induced energy amounted to 4.86 million Btu during May.

The large amount of solar energy lost from the rock thermal storage (25.23 million Btu) is believed to have migrated to the building and contributed to satisfying the space heating demand. Thus, the measured space heating demand, when combined with the circulating fan and the rock thermal storage energy contributions, results in an indicated space heating demand of 44.39 million Btu, which compares favorably with the predicted load of 46.9 million Btu.

D. Observations

The performance of the solar energy system continued to improve over the winter months. The collector array efficiency normally increases as the operating point moves from winter to spring. This is consistent with an air system in which the collector array return air temperature is nearly constant, which is the case for the Northview Elementary School (Howards Grove) solar energy system. As the ambient outside temperature rises, the operating point shifts toward lower values and the collector efficiency increases.

E. Energy Savings

The solar energy system installed in Howards Grove School resulted in an indicated savings of 11.14 million Btu (77 gallons) of fuel oil during May at an expense of 1.88 million Btu (550 kwh) of electrical operating energy. The space heating energy savings calculations are based on the energy requirements of a conventional propane-fired furnace with an efficiency of 76 percent compared to the energy requirements of the solar energy system.

The actual solar energy system's savings must include not only the direct solar contribution from the rock thermal storage, but also the thermal l contribution to the space heating demand. In addition, the fan energy tribution should be considered an auxiliary contribution to the space demand. When these additional energy contributions are considered, t

savings become 44.34 million Btu (308 gallons) of fuel oil. Also, the solar contribution to the space heating load increases from 64 percent to 76 percent.

III. ACTION STATUS

Additional instrumentation is being suggested to resolve the discrepancy between space heating demand measured by different instrumentation sensor sets. This would allow a more accurate determination of solar energy contribution and identify the source of the faulty sensor indications.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS — SOLAR/2041-79/05
REPORT PERIOD: MAY,1979

SITE/SYSTEM DESCRIPTION:
THE HOWARD GROVE SOLAR ENERGY SYSTEM PROVIDES SPACE HEATING FOR A 12,330 SQUARE FOOT ADDITION TO THE NORTHVIEW ELEMENTARY SCHOOL IN HOWARDS GROVE, WIS. THE SYSTEM USES AIR AS THE ENERGY TRANSFER MEDIUM, 2685 SQUARE FEET OF COLLECTORS, TO COLLECT AND STORE SOLAR ENERGY IN A 1500 CU. FT. ROCK STORAGE UNIT. RETURN AIR FROM THE SCHOOL IS DIRECTED THROUGH THE ROCK UNIT FOR SPACE HEATING. AUXILIARY HEAT IS PROVIDED BY AN IN-DUCT HX SUPPLIED BY A FUEL OIL BOILER.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	124.414 MILLION BTU
	46328 BTU/SQ.FT.
COLLECTED SOLAR ENERGY	33.945 MILLION BTU
	12640 BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	53 DEGREES F
AVERAGE BUILDING TEMPERATURE	68 DEGREES F
ECSS SOLAR CONVERSION EFFICIENCY	0.07
ECSS OPERATING ENERGY	1.339 MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	6.463 MILLION BTU
TOTAL ENERGY CONSUMED	46.797 MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	13.323	N.A.	13.323 MILLION BTU
SOLAR FRACTION	N.A.	64	N.A.	64 PERCENT
SOLAR ENERGY USED	N.A.	8.467	N.A.	8.467 MILLION BTU
OPERATING ENERGY	N.A.	5.124	N.A.	6.463 MILLION BTU
AUX. THERMAL ENERGY	N.A.	4.856	N.A.	4.856 MILLION BTU
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. MILLION BTU
AUX. FOSSIL FUEL	N.A.	6.389	N.A.	6.389 MILLION BTU
ELECTRICAL SAVINGS	N.A.	-0.540	N.A.	-1.879 MILLION BTU
FOSSIL SAVINGS	N.A.	11.141	N.A.	11.141 MILLION BTU

SYSTEM PERFORMANCE FACTOR: 0.477

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS — SOLAR/2041-79/05
REPORT PERIOD: MAY,1979

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GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	131.256 GIGA JOULES
	526191 KJ/SQ.M.
COLLECTED SOLAR ENERGY	35.812 GIGA JOULES
	143540 KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	12 DEGREES C
AVERAGE BUILDING TEMPERATURE	20 DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.07
ECSS OPERATING ENERGY	1.412 GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	6.818 GIGA JOULES
TOTAL ENERGY CONSUMED	49.371 GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	N.A.	14.056	N.A.	14.056 GIGA JOULES
SOLAR FRACTION	N.A.	64	N.A.	64 PERCENT
SOLAR ENERGY USED	N.A.	8.933	N.A.	8.933 GIGA JOULES
OPERATING ENERGY	N.A.	5.406	N.A.	6.818 GIGA JOULES
AUX. THERMAL ENG	N.A.	5.123	N.A.	5.123 GIGA JOULES
AUX. ELECTRIC FUEL	N.A.	N.A.	N.A.	N.A. GIGA JOULES
AUX. FOSSIL FUEL	N.A.	6.741	N.A.	6.741 GIGA JOULES
ELECTRICAL SAVINGS	N.A.	-0.570	N.A.	-1.982 GIGA JOULES
FOSSIL SAVINGS	N.A.	11.754	N.A.	11.754 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 0.477

* DENOTES UNAVAILABLE DATA
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REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS — SOLAR/2041-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	3.093	44	0.383	N	0.038	N	0.124
2	0.652	43	0.194	O	0.000	O	0.298
3	5.153	46	0.802	T	0.048	T	0.156
4	5.160	41	1.057		0.057		0.205
5	1.119	40	0.347	A	0.002	A	0.310
6	3.866	44	0.226	P	0.034	P	0.058
7	5.250	61	0.529	P	0.062	P	0.101
8	4.652	72	0.210	L	0.060	L	0.045
9	3.594	52	0.104	I	0.036	I	0.029
10	5.225	66	0.266	C	0.060	C	0.051
11	2.867	57	0.234	A	0.032	A	0.082
12	2.962	48	0.000	B	0.035	B	0.000
13	2.639	50	0.000	L	0.015	L	0.000
14	4.811	55	0.450	E	0.057	E	0.094
15	4.643	51	0.283		0.055		0.061
16	5.711	50	0.232		0.055		0.041
17	5.030	57	0.218		0.058		0.043
18	3.253	68	0.266		0.034		0.082
19	2.070	54	0.000		0.020		0.000
20	5.366	56	0.000		0.046		0.000
21	5.588	48	0.375		0.053		0.067
22	2.478	50	0.289		0.026		0.117
23	1.742	46	0.272		0.011		0.156
24	5.977	50	0.169		0.056		0.028
25	6.002	52	0.294		0.062		0.049
26	6.303	54	0.000		0.053		0.000
27	2.268	54	0.000		0.071		0.000
28	5.375	56	0.514		0.053		0.096
29	5.541	55	0.195		0.056		0.035
30	2.185	52	0.339		0.036		0.155
31	3.838	62	0.220		0.056		0.057
SUM	124.414	-	8.467	N.A.	1.339	N.A.	-
AVG	4.013	53	0.273	N.A.	0.043	N.A.	0.068
NBS ID	Q001	N113			Q102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS SOLAR/2041-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	3.093	2.214	0.811	53	0.262
2	0.652	0.000	0.000	45	0.000
3	5.153	4.705	1.793	52	0.348
4	5.160	4.645	1.690	50	0.328
5	1.119	0.059	0.012	*	0.010
6	3.866	2.975	0.850	46	0.220
7	5.250	5.059	1.807	68	0.344
8	4.652	4.359	1.615	79	0.347
9	3.594	2.955	1.112	56	0.309
10	5.225	4.990	1.961	81	0.375
11	2.867	1.952	0.525	57	0.183
12	2.962	1.949	0.341	54	0.115
13	2.639	1.307	0.244	59	0.093
14	4.811	4.491	1.532	63	0.319
15	4.643	4.195	1.462	60	0.315
16	5.711	5.235	1.874	61	0.328
17	5.030	4.713	1.559	62	0.310
18	3.253	2.756	1.070	81	0.329
19	2.070	1.131	0.202	*	0.098
20	5.366	4.462	0.837	68	0.156
21	5.588	5.016	1.511	53	0.270
22	2.478	1.521	0.476	56	0.192
23	1.742	0.432	0.093	48	0.053
24	5.977	5.406	1.922	56	0.322
25	6.002	5.739	2.000	60	0.333
26	6.303	5.487	1.230	*	0.195
27	2.268	1.591	-0.155	*	-0.068
28	5.375	4.724	1.669	*	0.310
29	5.541	5.209	1.896	60	0.342
30	2.185	1.816	0.573	55	0.262
31	3.838	3.412	1.433	74	0.373
SUM	124.414	104.506	33.945	-	-
AVG	4.013	3.371	1.095	60	0.273
NBSID	Q001		Q100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS SOLAR/2041-79/05
REPORT PERIOD: MAY,1979

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.782	0.383	0.189	69	0.732
2	0.000	0.194	-0.211	67	1.000
3	1.654	0.802	0.464	73	0.765
4	1.639	1.057	0.054	80	0.678
5	0.016	0.347	-0.353	82	-0.377
6	0.993	0.226	0.414	75	0.645
7	1.838	0.529	0.271	88	0.436
8	1.581	0.210	0.208	97	0.265
9	1.062	0.104	-0.225	94	-0.114
10	1.826	0.266	0.303	98	0.312
11	0.581	0.234	-0.399	94	-0.285
12	0.461	0.000	0.142	93	0.307
13	0.317	0.000	0.133	98	0.420
14	1.560	0.450	-0.170	94	0.180
15	1.513	0.283	0.029	93	0.206
16	1.857	0.232	0.103	95	0.180
17	1.538	0.218	-0.043	96	0.114
18	0.999	0.266	-0.040	97	0.227
19	0.265	0.000	0.042	97	0.160
20	1.100	0.000	0.488	107	0.444
21	1.537	0.375	-0.374	103	0.000
22	0.499	0.289	-0.592	89	-0.607
23	0.117	0.272	-0.349	72	-0.660
24	1.906	0.169	0.517	78	0.360
25	2.025	0.294	0.277	90	0.282
26	1.642	0.000	0.621	108	0.378
27	-0.422	0.000	-0.519	109	1.229
28	1.691	0.514	-0.086	94	0.253
29	1.863	0.195	0.191	98	0.207
30	0.644	0.339	-0.560	88	-0.344
31	1.398	0.220	0.253	87	0.338
SUM	34.481	8.467	0.783	-	-
AVG	1.112	0.273	0.025	90	0.268
NBS ID	Q200	Q201	Q202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS
REPORT PERIOD: MAY,1979

SOLAR/2041-79/05

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.656	58	0.383	0.331	0.273	N	0.360	0.133	0.504	63	44
2	0.464	42	0.194	0.237	0.270	O	0.355	0.037	0.255	63	43
3	1.071	75	0.802	0.363	0.269	T	0.354	0.157	1.055	64	46
4	1.333	79	1.057	0.262	0.276		0.363	0.262	1.391	64	41
5	0.640	54	0.347	0.085	0.293	A	0.386	0.093	0.457	63	40
6	0.455	50	0.226	0.270	0.229	P	0.302	0.054	0.297	63	44
7	0.625	85	0.529	0.186	0.096	P	0.126	0.011	0.696	66	61
8	0.210	100	0.210	0.162	0.000	L	0.000	-0.162	0.276	70	72
9	0.240	43	0.104	0.150	0.137	I	0.180	-0.086	0.137	70	52
10	0.341	78	0.266	0.152	0.075	C	0.098	-0.096	0.350	71	66
11	0.269	87	0.234	0.181	0.035	A	0.047	-0.177	0.307	72	57
12	0.172	0	0.000	0.021	0.172	B	0.226	-0.000	0.000	68	48
13	0.170	0	0.000	0.021	0.170	L	0.224	-0.000	0.000	66	50
14	0.614	73	0.450	0.197	0.164	E	0.216	-0.002	0.592	68	55
15	0.428	66	0.283	0.182	0.145		0.191	-0.030	0.372	70	51
16	0.408	57	0.232	0.184	0.176		0.232	0.005	0.305	70	50
17	0.292	75	0.218	0.165	0.074		0.097	-0.154	0.287	71	57
18	0.266	100	0.266	0.172	0.000		0.000	-0.172	0.350	72	68
19	0.057	0	0.000	0.008	0.057		0.076	-0.001	0.000	70	54
20	0.135	0	0.000	0.016	0.135		0.177	-0.000	0.000	69	56
21	0.506	74	0.375	0.173	0.131		0.172	-0.150	0.493	70	48
22	0.472	61	0.289	0.206	0.183		0.241	-0.064	0.381	70	50
23	0.551	49	0.272	0.227	0.279		0.367	0.086	0.358	68	46
24	0.417	41	0.169	0.238	0.248		0.326	0.061	0.222	67	50
25	0.479	61	0.294	0.183	0.185		0.243	0.025	0.387	68	52
26	0.127	0	0.000	0.015	0.127		0.168	-0.000	0.000	67	54
27	0.117	0	0.000	0.014	0.117		0.154	-0.000	0.000	67	54
28	0.622	83	0.514	0.199	0.108		0.143	-0.183	0.676	69	56
29	0.326	60	0.195	0.126	0.131		0.172	-0.104	0.257	71	55
30	0.529	64	0.339	0.206	0.190		0.251	-0.074	0.445	71	52
31	0.330	67	0.220	0.189	0.110		0.145	-0.008	0.289	72	62
SUM	13.323	-	8.467	5.124	4.856	N.A.	6.389	-0.540	11.141	-	-
AVG	0.430	64	0.273	0.165	0.157	N.A.	0.206	-0.017	0.359	68	53
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: HOWARDS GROVE SCHOOL, HOWARDS GROVE,WIS
REPORT PERIOD: MAY,1979

SOLAR/2041-79/05

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1152	N	44	53	N	159	3
2	243	O	43	45	O	98	4
3	1919	T	46	52	T	338	8
4	1921		41	50		*	2
5	417	A	40	*	A	143	3
6	1439	P	44	46	P	67	4
7	1955	P	61	68	P	161	5
8	1732	L	72	79	L	177	6
9	1338	I	52	56	I	42	5
10	1946	C	66	81	C	162	4
11	1067	A	57	57	A	276	8
12	1103	B	48	54	B	0	1
13	983	L	50	59	L	176	3
14	1791	E	55	63	E	268	4
15	1729		51	60		0	2
16	2127		50	61		131	3
17	1873		57	62		164	8
18	1211		68	81		210	6
19	771		54	*		*	3
20	1998		56	68		285	7
21	2081		48	53		30	3
22	923		50	56		0	1
23	649		46	48		12	6
24	2226		50	56		27	5
25	2235		52	60		29	5
26	2347		54	*		15	5
27	844		54	*		0	1
28	2002		56	*		0	2
29	2063		55	60		57	3
30	814		52	55		0	2
31	1429		62	74		0	2
SUM	46328	N.A.	-	-	-	-	-
AVG	1494	N.A.	53	60	N.A.	*	4
NBS ID	Q001		N113			N115	N114

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